

# Feasibility of Predicted Heart Mass in Patients with Single Ventricle Physiology

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## INTRODUCTION

- The Fontan procedure is a palliative surgical procedure employed in patients with single ventricle congenital defects.<sup>1</sup>

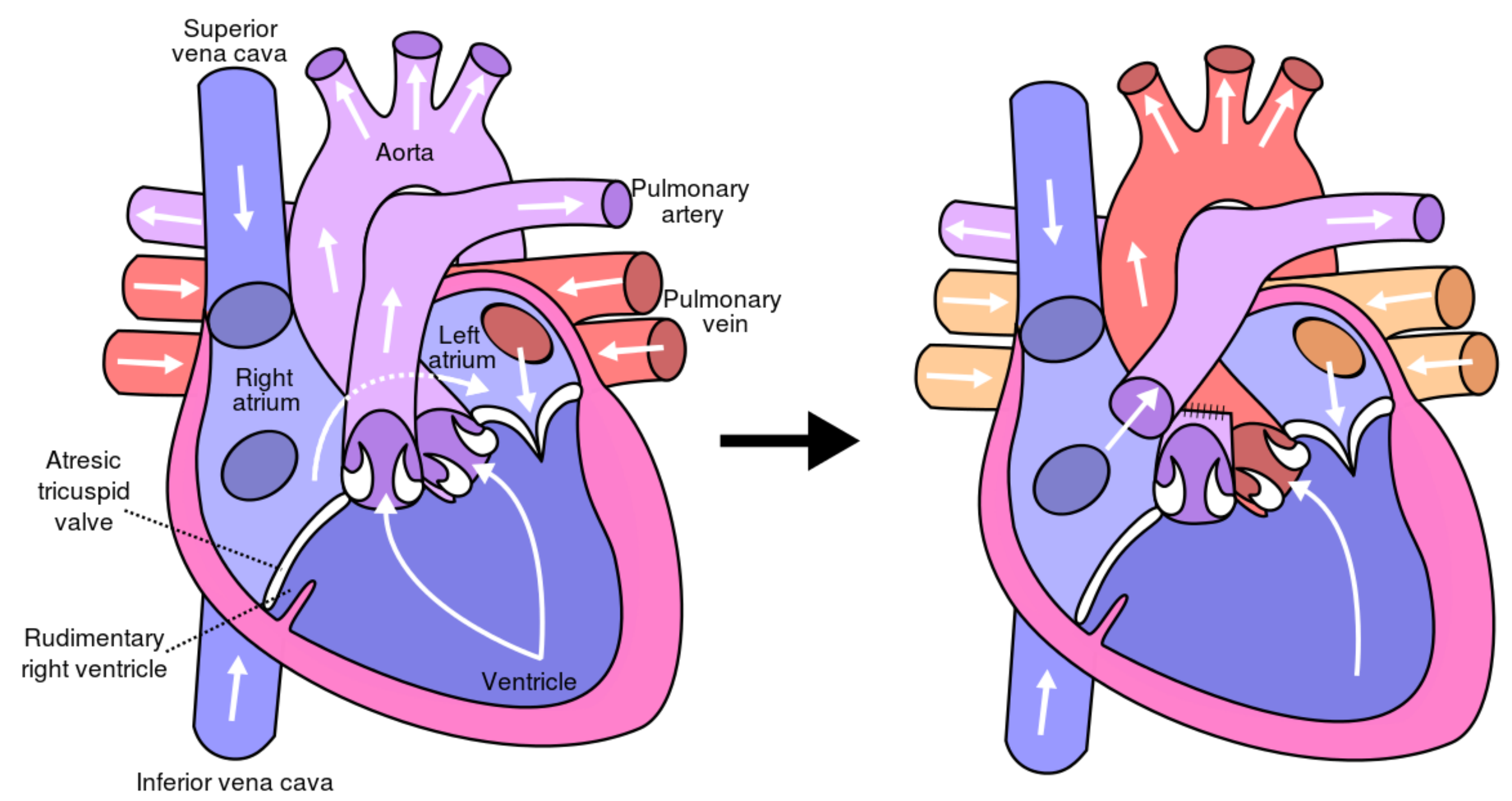


Figure 1. Fontan procedure for tricuspid atresia<sup>6</sup>

- Fontan patients may require orthotopic heart transplant (OHT) or combined heart-liver transplant (CHLT) as a final therapeutic option.<sup>1</sup>
- Single ventricle patients have been shown to have 3x higher risk of in-hospital mortality post OHT vs patients with biventricular physiology.<sup>5</sup>
- Predicted heart mass (PHM) has been found to be the optimal size match metric in predicting mortality post heart transplant.<sup>3</sup>
- Undersizing donor hearts (PHM ratio <0.83) is associated with increased mortality<sup>3</sup>; however, questions remain regarding how to properly size donor organs in Fontan patients.<sup>1</sup> At UCLA, we currently consider donor to recipient height ratios, weight ratios, age; cross-sectional imaging to directly measure donor and recipient cardiac and liver dimensions.
- In adults with Fontan physiology, we sought to understand:
  - The utility of PHM in sizing donor organs for OHT/CHLT
  - Optimal donor heart sizing for OHT vs CHLT
  - Factors predicting improved survival vs morbidity

## METHODS

- Retrospectively, 30 adult patients with failing Fontan physiology who underwent OHT/CHLT at UCLA from 2010-2020 were identified for a descriptive analysis of clinical data.
- Data collected included patient history, donor/recipient organ listing details, and transplant details.
- PHM and PHM ratios were calculated using the Calculate by QxMD Calculator<sup>7</sup> and the UNOS PHM Match Calculator.<sup>8</sup>

## RESULTS

Table 1. Combined Heart/Liver Transplants at UCLA, 2010-2020

Congenital Heart Diagnosis	Heterotaxy (Y/N)	Age at Transplant (years)	Recipient PHM (g)	Donor PHM (g)	Donor: Recipient PHM	Outcome
L-TGA, TA	N	33.93	162.93	167.82	1.03	Alive 10 mo post-tpx
TA	N	32.25	185.61	206.03	1.11	Alive 10 mo post-tpx
DORV, L-TGA	N	23.91	96.93	125.04	1.29	Alive 1.5 yrs post-tpx
TA	N	40.37	139.44	138.46	0.993	Alive 2 yrs, 4 mo post-tpx
DILV	N	53.28	180.11	181.70	1.01	Alive 2 yrs, 7 mo post-tpx
CAVC	N	43.20	140.85	180.29	1.28	Expired 4 days post-tpx (anoxic brain injury)
TA	N	39.54	116.17	153.34	1.32	Alive 4 yrs, 3 mo post-tpx
TA	N	40.11	181.12	195.61	1.08	Alive 4 yrs, 9 mo post-tpx
HLHS	N	20.67	170.74	177.57	1.04	Alive 7 yrs, 6 mo post-tpx
DORV, VSD	N	30.44	122.67	152.11	1.24	Alive 9 yrs, 2 mo post-tpx

L-TGA = left transposition of great arteries, TA= tricuspid atresia, DORV = double outlet right ventricle, DILV = double inlet left ventricle, CAVC= complete atrioventricular canal defect, HLHS = hypoplastic left heart syndrome, VSD = ventricular septal defect, Tpx=transplant

Table 2. Orthotopic Heart Transplants at UCLA, 2010-2020

Congenital Heart Diagnosis	Heterotaxy (Y/N)	Age at Transplant (years)	Recipient PHM (g)	Donor PHM (g)	Donor: Recipient PHM	Outcome
DILV, L-TGA	N	36.68	129.55	185.26	1.43	Alive 10 mo post-tpx
Unbalanced AV Canal	Y	40.05	192.85	202.49	1.05	Alive 1 yr, 1 mo post-tpx
Unbalanced AV Canal	Y	18.78	196.42	157.14	0.80	Alive 1 yr, 6 mo post-tpx
TA	N	22.33	95.22	113.31	1.19	Alive 5 yrs, 3 mo post-tpx
Unbalanced AV Canal	N	20.35	150.54	173.12	1.15	Expired 2 yrs, 21 days post-tpx (sudden death)
L-TGA, TA	N	43.54	164.93	174.83	1.06	Alive 7 yrs, 8 mo post-tpx
Unbalanced AV Canal	Y	25.47	116.24	168.55	1.45	Alive 7 yrs, 10 mo post-tpx
DORV, Mitral Atresia	Y	22.45	111.02	115.46	1.04	Alive 8 yrs, 1 mo post-tpx
TA	N	45.85	184.04	176.68	0.96	Alive 8 yrs, 9 mo post-tpx
TA	N	43.50	120.94	150.42	1.31	Alive 10 yrs, 1 mo post-tpx
D-TGA, VSD, Pulmonary Atresia	N	33.75	116.44	131.58	1.13	Alive 10 yrs, 5 mo post-tpx
DILV	N	32.84	154.62	180.91	1.17	Alive 11 yrs, 2 mo post-tpx
TA	N	35.15	114.10	123.23	1.08	Alive 11 yrs, 4 mo post-tpx

L-TGA = left transposition of great arteries, TA= tricuspid atresia, DORV = double outlet right ventricle, DILV = double inlet left ventricle, CAVC= complete atrioventricular canal defect, HLHS = hypoplastic left heart syndrome, VSD = ventricular septal defect, Tpx=transplant

Table 3. Comparison of PHM ratios for CHLT vs OHT

Transplant Type	Donor: Recipient PHM Ratio
Combined Heart/Liver (mean, std dev)	1.14±0.13
Orthotopic Heart (mean, std dev)	1.14±0.18

## CONCLUSION

- When using our current selection factors, the donor to recipient PHM ratio would be considered “moderately oversized.”
- Despite concern for oversized donor livers, mean donor to recipient PHM ratios in our patient population were comparable for OHT vs CHLT.
- Limitations of this study:
  - Though UCLA performs a high volume of Fontan OHT/CHLTs, the patient population remains small, thus making it difficult to draw conclusions about factors impacting survival.
- Differences in surgeons, technique, and approach to risk modification are important confounders.

## FUTURE DIRECTIONS

- Multicenter study pooling experience for additional insight into donor size selection.
  - May again prove difficult to draw conclusions about outcomes given highly variable practice patterns.
- Further investigation of factors predicting survival and morbidity are warranted for this specialized patient population.

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